LISTING OF CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) In an initiator agent, a method for determining performance of a network link between the initiator agent and a target agent, the method comprising:

creating a measurement packet group containing a set of measurement packets, each measurement packet in the measurement packet group containing a respective measurement packet identity relative to other measurement packets in the measurement packet group and containing at least one measurement performance metric associated with the initiator agent, by, for each measurement packet:

calculating a measurement sequence number for that measurement packet that indicates the measurement packet identity relative to a total number of measurement packets to be created within the measurement packet group;

inserting the measurement sequence number for that measurement packet into the measurement packet; and

inserting a measurement group count into the measurement packet, the measurement group count indicating the total number of measurement packets to be created within the measurement packet group, the measurement sequence number and measurement group count allowing the target agent to compute a packet loss metric of measurement packets within the measurement packet group;

forwarding each measurement packet in the measurement packet group to a target agent over a communications network supporting communication between the initiator agent and the target agent;

repeating creation of each measurement packet and forwarding of each measurement packet in a sequence for each measurement packet of the measurement packet group, such that measurement packets in the measurement packet group are forwarded to the target agent in a sequence;

receiving a response packet group containing a set of response packets from the target agent, each response packet containing at least one target performance metric calculated by the target agent using the measurement performance metric in a corresponding measurement packet of the measurement packet group, wherein receiving comprises, for each response packet:

identifying a response sequence number within that response packet; and

identifying a response group count within that response packet, the response group count indicating the total number of response packets to be created within the response packet group for transmission to the initiator agent; and

calculating at least one network link metric from the at least one target performance metric in each response packet of the response packet group, the at least one network link metric identifying a packet latency and packet loss rate between the initiator agent and target agent, wherein calculating comprises:

identifying a completion event for receipt of the response packet group, and in response to identifying the completion event, determining at least one packet loss metric of packets lost in transmission between the initiator agent and target agent based upon received response sequence numbers and a total number of packets in a packet group identified by the response group count.

2. (Canceled)

3. (Canceled)

4. (Previously Presented) The method of claim 1 wherein forwarding each measurement packet in the measurement packet group to a target agent comprises, for each measurement packet:

generating a measurement transmit timestamp for that measurement packet;

inserting the measurement transmit timestamp as the measurement performance metric into the measurement packet, the measurement transmit timestamp allowing the

target agent to compute a measurement packet one way travel time between the initiator agent and the target agent upon receipt of that measurement packet by the target agent; and

transmitting the measurement packet containing the sequence number for that measurement packet, the group count, and the measurement transmit timestamp to the target agent.

5. (Original) The method of claim 4 wherein receiving each response packet in the response packet group at the initiator agent comprises, for each response packet:

receiving the response packet at the initiator device;

generating a response receipt timestamp for the response packet;

obtaining, within the response packet, a target processing timestamp as the at least one target performance metric calculated by the target agent, the target processing timestamp indicating a time at which the target agent processed a measurement packet of the measurement packet group to produce the response packet, the response receipt timestamp and the target processing timestamp allowing the initiator agent to compute a one way travel time for packets transmitted between the target agent and the initiator agent upon receipt of that response packet by the initiator agent.

6. (Original) The method of claim 5 wherein calculating at least one network link metric from the at least one target performance metric in each response packet of the response packet group comprises, for each response packet:

calculating the at least one network link metric in association with the response packet, the at least one network link metric including at least one of:

i) a response packet one way travel time between the target agent and the initiator agent as a time difference between the target processing timestamp and the response receipt timestamp; and

ii) a measurement packet one way travel time between the initiator agent and the target agent as a time difference between the measurement

transmit timestamp for a measurement packet that corresponds with the received response packet and the target processing timestamp that the target agent includes within the response packet;

iii) a round trip travel time for transmission of a measurement packet from the initiator agent to the target agent and receipt of a corresponding response packet transmitted from the target agent to the initiator agent.

7. (Original) The method of claim 6 comprising repeating receiving each response packet and calculating at least one network link metric in a sequence for each response packet of the response packet group, such that a respective at least one network link metric is calculated for each response packet.

8. (Original) The method of claim 7 wherein calculating the at least one network link metric in association with the response packet comprises:

calculating an average one way travel time between the initiator agent and the target agent for packets in at least one of measurement packet group and the response packet group; and

calculating an average round trip travel time for transmission of a measurement packet in the measurement packet group sent from the initiator agent to the target agent and for receipt of corresponding response packets in the response packet group that were transmitted from the target agent to the initiator agent.

9. (Original) The method of claim 8 comprising:

maintaining clock synchronization between the initiator agent and the target agent.

10. (Canceled)

11. (Currently Amended) The method of claim [[10]]1 wherein the at least one packet loss metric includes at least one of:

a round trip packet loss metric;

a one way packet loss metric of packets transmitted from the initiator agent to the target agent; and

a one way packet loss metric of packets transmitted from the target agent to the initiator agent.

12. (Original) The method of claim 8 wherein the measurement packets and the response packets include a packet verification identity including cryptographic information allowing the initiator agent and target agent to verify their identity using a crypto graphic verification process; and

wherein creating a measurement packet group containing a set of measurement packets comprises, for each measurement packet

inserting an initiator communications port identity into each measurement packet allowing the target agent to identify a communications port on the initiator agent to which to transmit response packets in response to receiving each measurement packet; and

wherein receiving a response packet group comprises:

opening a communications port for reception of response packets in the response packet group, the communications port corresponding to the initiator communications port identity specified in the measurement packets of the measurement packet group; and

identifying a completion event for receipt of the response packet group, and in response to the completion event, closing the communications port to prevent unauthorized communications on the communications port during times when no response packets are expected.

13. (Original) The method of claim 1 wherein creating a measurement packet group comprises:

for each measurement packet, inserting an amount of payload data into the measurement packet; and

wherein each response packet in the response packet group includes a copy of the payload data within a corresponding measurement packet of the measurement packet group, and wherein the method comprises:

repeating creation of each measurement packet, forwarding of each measurement packet of the measurement packet group, receiving a response packet group and calculating at least one network link metric in a sequence of multiple iterations,

and for each measurement packet group in each iteration in the sequence of iterations, adjusting the amount of payload data inserted into the measurement packet sequence group to identify how the calculated at least one network link metric changes based on the adjusted amount of payload data, at least one of the amounts of payload data inserted into the measurement packet causing an overall size of the measurement packet to substantially reflect application level traffic between the initiator agent and the target agent.

14. (Currently Amended) In an target agent, a method for determining performance of a network link between the target agent and an initiator agent, the method comprising:

receiving a measurement packet group containing a set of measurement packets, each measurement packet in the measurement packet group containing a respective measurement packet identity relative to other measurement packets in the measurement packet group and containing at least one measurement performance metric associated with the initiator agent, and for each measurement packet:

generating a target processing timestamp upon receipt of the measurement packet, the target processing timestamp associated with the measurement packet received and indicating a time at which the target agent receives the measurement packet;

obtaining a measurement group count from the measurement packet, the measurement group count indicating the total number of measurement packets to be received within the measurement packet group;

obtaining a measurement sequence number from that measurement packet, the measurement sequence number indicating the measurement packet identity of that measurement packet relative to a total number of measurement packets to be created within the measurement packet group as indicated by the measurement group count; and

obtaining a measurement transmit timestamp as the measurement performance metric from the measurement packet, the measurement transmit timestamp indicating a time at which the initiator agent transmitted the measurement packet to the target agent;

calculating at least one target performance metric for each measurement packet received in the measurement packet group, the at least one target performance metric calculated using the measurement performance metric and measurement packet identity from a corresponding measurement packet of the measurement packet group, the at least one target performance metric identifying a packet latency and packet loss metrics for measurement packets transferred between the initiator agent and target agent;

creating a response packet group containing a set of response packets, each response packet containing the at least one target performance metric calculated by the target agent using the measurement performance metric from a corresponding measurement packet of the measurement packet group, wherein creating comprises, for each response packet:

identifying a response sequence number within that response packet; and

identifying a response group count within that response packet, the response group count indicating the total number of response packets to be created within the response packet group for transmission to the initiator agent; and

forwarding each response packet in the response packet group to the initiator agent over a communications network supporting communication between the initiator agent and the target agent.

15. (Canceled)

16. (Previously Presented) The method of claim 14 wherein calculating at least one target performance metric for each measurement packet received in the measurement packet group comprises:

calculating, as the at least one network link metric in association with the measurement packet, a measurement packet one way travel time between the initiator agent and the target agent as a time difference between the measurement transmit timestamp for a measurement packet that corresponds with the received response packet and the target processing timestamp that the target agent generates upon receipt of the measurement packet.

17. (Previously Presented) The method of claim 14 wherein calculating at least one target performance metric for each measurement packet received in the measurement packet group further comprises:

identifying a completion event for receipt of the measurement packet group, and in response to identifying the completion event:

i) calculating a packet loss metric of packets lost in transmission between the initiator agent and target agent based upon received measurement sequence numbers and a total number of packets in a measurement packet group identified by the measurement group count; and

ii) calculating an average one way travel time for measurement packets transmitted between the initiator agent and the target agent in the measurement packet group by averaging the measurement packet one way travel time across a number of measurement packets received.

18. (Original) The method of claim 17 wherein creating a response packet group containing a set of response packets comprises:

    for each measurement packet received in the measurement packet group:

        i) copying the contents of that measurement packet into a corresponding response packet generated and corresponding to that measurement packet;

        ii) inserting the target processing timestamp into the response packet;

        iii) inserting at least one of the packet loss metric and the average one way travel time for measurement packets as the at least one target performance metric within the response packet; and

        performing the operation of forwarding that response packet of the response packet group to the initiator agent.

19. (Currently Amended) An initiator agent computer system comprising:

    a memory;

    a processor;

    a communications interface; and

    an interconnection mechanism coupling the memory, the processor and the communications interface;

    wherein the memory is encoded with an initiator agent application that when performed on the processor, provides an initiator agent process that when executed on the processor determines performance of a network link between the initiator agent computer system and a target agent computer system by causing the initiator agent computer system to perform the operations of:

    creating a measurement packet group containing a set of measurement packets, each measurement packet in the measurement packet group containing a respective measurement packet identity relative to other measurement packets in the measurement packet group and containing at least one measurement performance metric associated with the initiator agent, by, for each measurement packet:

calculating a measurement sequence number for that measurement packet that indicates the measurement packet identity relative to a total number of measurement packets to be created within the measurement packet group;

inserting the measurement sequence number for that measurement packet into the measurement packet; and

inserting a measurement group count into the measurement packet, the measurement group count indicating the total number of measurement packets to be created within the measurement packet group, the measurement sequence number and measurement group count allowing the target agent to compute a packet loss metric of measurement packets within the measurement packet group;

forwarding each measurement packet in the measurement packet group to a target agent over a communications network supporting communication between the initiator agent and the target agent;

repeating creation of each measurement packet and forwarding of each measurement packet in a sequence for each measurement packet of the measurement packet group, such that measurement packets in the measurement packet group are forwarded to the target agent in a sequence;

receiving a response packet group containing a set of response packets from the target agent, each response packet containing at least one target performance metric calculated by the target agent using the measurement performance metric in a corresponding measurement packet of the measurement packet group, wherein receiving comprises, for each response packet:

identifying a response sequence number within that response packet; and

identifying a response group count within that response packet, the response group count indicating the total number of response packets to be created within the response packet group for transmission to the initiator agent; and

calculating at least one network link metric from the at least one target performance metric in each response packet of the response packet group, the at least

one network link metric identifying a packet latency and packet loss rate between the initiator agent and target agent, wherein calculating comprises:

identifying a completion event for receipt of the response packet group, and in response to identifying the completion event, determining at least one packet loss metric of packets lost in transmission between the initiator agent and target agent based upon received response sequence numbers and a total number of packets in a packet group identified by the response group count.

20. (Canceled)

21. (Canceled)

22. (Previously Presented) The initiator agent computer system of claim 19 wherein when the initiator agent process causes the initiator agent computer system to perform the operation of forwarding each measurement packet in the measurement packet group to a target agent, the initiator agent process causes the initiator agent computer system to perform the operations of, for each measurement packet:

generating a measurement transmit timestamp for that measurement packet;

inserting the measurement transmit timestamp as the measurement performance metric into the measurement packet, the measurement transmit timestamp allowing the target agent to compute a measurement packet one way travel time between the initiator agent and the target agent upon receipt of that measurement packet by the target agent; and

transmitting the measurement packet containing the sequence number for that measurement packet, the group count, and the measurement transmit timestamp to the target agent.

23. (Original) The initiator agent computer system of claim 22 wherein when the initiator agent process causes the initiator agent computer system to perform the operation of receiving each response packet in the response packet group at the

initiator agent, the initiator agent process causes the initiator agent computer system to perform the operation of, for each response packet:

receiving the response packet at the initiator device;

generating a response receipt timestamp for the response packet;

obtaining, within the response packet, a target processing timestamp as the at least one target performance metric calculated by the target agent, the target processing timestamp indicating a time at which the target agent processed a measurement packet of the measurement packet group to produce the response packet, the response receipt timestamp and the target processing timestamp allowing the initiator agent to compute a one way travel time for packets transmitted between the target agent and the initiator agent upon receipt of that response packet by the initiator agent.

24. (Original) The initiator agent computer system of claim 23 wherein when the initiator agent process causes the initiator agent computer system to perform the operation of calculating at least one network link metric from the at least one target performance metric in each response packet of the response packet group, the initiator agent process causes the initiator agent computer system to perform the operations of, for each response packet:

calculating the at least one network link metric in association with the response packet, the at least one network link metric including at least one of:

i) a response packet one way travel time between the target agent and the initiator agent as a time difference between the target processing timestamp and the response receipt timestamp; and

ii) a measurement packet one way travel time between the initiator agent and the target agent as a time difference between the measurement transmit timestamp for a measurement packet that corresponds with the received response packet and the target processing timestamp that the target agent includes within the response packet;

iii) a round trip travel time for transmission of a measurement
packet from the initiator agent to the target agent and receipt of a
corresponding response packet transmitted from the target agent to the
initiator agent.

25. (Original) The initiator agent computer system of claim 24 wherein the initiator
agent process causes the initiator agent computer system to perform the operation of
repeating receiving each response packet and calculating at least one network link
metric in a sequence for each response packet of the response packet group, such that
a respective at least one network link metric is calculated for each response packet.

26. (Original) The initiator agent computer system of claim 25 wherein when the
initiator agent process causes the initiator agent computer system to perform the
operation of calculating the at least one network link metric in association with the
response packet, the initiator agent process causes the initiator agent computer system
to perform the operation of:
    calculating an average one way travel time between the initiator agent and the
target agent for packets in at least one of measurement packet group and the response
packet group; and
    calculating an average round trip travel time for transmission of a measurement
packet in the measurement packet group sent from the initiator agent to the target agent
and for receipt of corresponding response packets in the response packet group that
were transmitted from the target agent to the initiator agent.

27. (Previously Presented) The initiator agent computer system of claim 26 wherein
the initiator agent process causes the initiator agent computer system to perform the
operation of:
    maintaining clock synchronization between the initiator agent and the target
agent.

28. (Canceled)

29. (Currently Amended) The initiator agent computer system of claim [[28]]19 wherein the at least one packet loss metric includes at least one of:

a round trip packet loss metric;

a one way packet loss metric of packets transmitted from the initiator agent to the target agent; and

a one way packet loss metric of packets transmitted from the target agent to the initiator agent.

30. (Original) The initiator agent computer system of claim 26 wherein the measurement packets and the response packets include a packet verification identity including cryptographic information allowing the initiator agent and target agent to verify their identity using a cryptographic verification process; and

wherein when the initiator agent process causes the initiator agent computer system to perform the operation of creating a measurement packet group containing a set of measurement packets, the initiator agent process causes the initiator agent computer system to perform the operation of, for each measurement packet:

inserting an initiator communications port identity into each measurement packet allowing the target agent to identify a communications port on the initiator agent to which to transmit response packets in response to receiving each measurement packet; and

wherein when the initiator agent process causes the initiator agent computer system to perform the operation of receiving a response packet group, the initiator agent process causes the initiator agent computer system to perform the operations of:

opening a communications port for reception of response packets in the response packet group, the communications port corresponding to the initiator communications port identity specified in the measurement packets of the measurement packet group; and

identifying a completion event for receipt of the response packet group, and in response to the completion event, closing the communications port to prevent unauthorized communications on the communications port during times when no response packets are expected.

31. (Original) The initiator agent computer system of claim 19 wherein when the initiator agent process causes the initiator agent computer system to perform the operation of creating a measurement packet group, the initiator agent process causes the initiator agent computer system to perform the operation of:

for each measurement packet, inserting an amount of payload data into the measurement packet; and

wherein each response packet in the response packet group includes a copy of the payload data within a corresponding measurement packet of the measurement packet group, and wherein the initiator agent process causes the initiator agent computer system to perform the operation of:

repeating creation of each measurement packet, forwarding of each measurement packet of the measurement packet group, receiving a response packet group and calculating at least one network link metric in a sequence of multiple iterations, and for each measurement packet group in each iteration in the sequence of iterations, adjusting the amount of payload data inserted into the measurement packet sequence group to identify how the calculated at least one network link metric changes based on the adjusted amount of payload data, at least one of the amounts of payload data inserted into the measurement packet causing an overall size of the measurement packet to substantially reflect application level traffic between the initiator agent and the target agent.

32. (Currently Amended) An target agent computer system comprising:

a memory;

a processor;

a communications interface; and

an interconnection mechanism coupling the memory, the processor and the communications interface;

wherein the memory is encoded with a target agent application that when performed on the processor, provides a target agent process that when executed on the processor determines performance of a network link between an initiator agent computer system and the target agent computer system by causing the target agent computer system to perform the operations of:

receiving, via the communications interface, a measurement packet group containing a set of measurement packets, each measurement packet in the measurement packet group containing a respective measurement packet identity relative to other measurement packets in the measurement packet group and containing at least one measurement performance metric associated with the initiator agent, and for each measurement packet:

generating a target processing timestamp upon receipt of the measurement packet, the target processing timestamp associated with the measurement packet received and indicating a time at which the target agent receives the measurement packet;

obtaining a measurement group count from the measurement packet, the measurement group count indicating the total number of measurement packets to be received within the measurement packet group;

obtaining a measurement sequence number from that measurement packet, the measurement sequence number indicating the measurement packet identity of that measurement packet relative to a total number of measurement packets to be created within the measurement packet group as indicated by the measurement group count; and

obtaining a measurement transmit timestamp as the measurement performance metric from the measurement packet, the measurement transmit timestamp indicating a time at which the initiator agent transmitted the measurement packet to the target agent;

calculating at least one target performance metric for each measurement packet received in the measurement packet group, the at least one target performance metric calculated using the measurement performance metric and measurement packet identity from a corresponding measurement packet of the measurement packet group, the at least one target performance metric identifying a packet latency and packet loss metrics for measurement packets transferred between the initiator agent and target agent;

creating a response packet group containing a set of response packets, each response packet containing the at least one target performance metric calculated by the target agent using the measurement performance metric from a corresponding measurement packet of the measurement packet group, wherein creating comprises, for each response packet:

identifying a response sequence number within that response packet; and

identifying a response group count within that response packet, the response group count indicating the total number of response packets to be created within the response packet group for transmission to the initiator agent; and

forwarding, via the communications interface, each response packet in the response packet group to the initiator agent over a communications network supporting communication between the initiator agent and the target agent.

33. (Canceled)

34. (Previously Presented) The target agent computer system of claim 32 wherein when the target agent process causes the target agent computer system to perform the operation of calculating at least one target performance metric for each measurement packet received in the measurement packet group, the target agent process causes the target agent computer system to perform the operation of:

calculating, as the at least one network link metric in association with the measurement packet, a measurement packet one way travel time between the initiator

agent and the target agent as a time difference between the measurement transmit timestamp for a measurement packet that corresponds with the received response packet and the target processing timestamp that the target agent generates upon receipt of the measurement packet.

35. (Previously Presented) The target agent computer system of claim 32 wherein when the target agent process causes the target agent computer system to perform the operation of calculating at least one target performance metric for each measurement packet received in the measurement packet group further, the target agent process causes the target agent computer system to perform the operations of:

identifying a completion event for receipt of the measurement packet group, and in response to identifying the completion event:

i) calculating a packet loss metric of packets lost in transmission between the initiator agent and target agent based upon received measurement sequence numbers and a total number of packets in a measurement packet group identified by the measurement group count; and

ii) calculating an average one way travel time for measurement packets transmitted between the initiator agent and the target agent in the measurement packet group by averaging the measurement packet one way travel time across a number of measurement packets received.

36. (Original) The target agent computer system of claim 35 wherein when the target agent process causes the target agent computer system to perform the operation of creating a response packet group containing a set of response packets wherein when the target agent process causes the target agent computer system to perform the operations of:

for each measurement packet received in the measurement packet group:

i) copying the contents of that measurement packet into a corresponding response packet generated and corresponding to that measurement packet;

ii) inserting the target processing timestamp into the response packet;

iii) inserting at least one of the packet loss metric and the average one way travel time for measurement packets as the at least one target performance metric within the response packet; and

performing the operation of forwarding that response packet of the response packet group to the initiator agent.

37. (Previously Presented) The method of claim 1 wherein receiving a response packet group comprises:

receiving a response packet group containing a set of response packets from the target agent, each response packet containing at least one target performance metric calculated by the target agent using the measurement performance metric in a corresponding measurement packet of the measurement packet group, each response packet containing a copy of the measurement sequence number and measurement group count of the corresponding measurement packet.

38. (Previously Presented) The method of claim 37 comprising:

for each response packet received, determining which measurement packet forwarded to the target agent resulted in the creation of that response packet by using the copy of the measurement sequence number and measurement group count from that response packet.